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European Patent Office

Office européen des brevets

(11)

EP!0!743!029!B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
17.07.2002 Bulletin 2002/29

(51) Int CI.⁷: **A46B 15/00**, A61 N 5/06,
A46B 11/06, A46B 5/00

(21) Application number: 96201093.0

(22) Date of filing: **24.04.1996**

(54) Dental cleaning treatment laser device

Zahnärztliche Laservorrichtung zur Reinigungsbehandlung

Dispositif laser de nettoyage et de traitement dentaire

(8⁴) Designated Contracting States:
DE GB

(56) References cited:

WO-A-95/10243

DE-A- 3824 838

DE-A- 3 937 850

(30) Priority: 26.04.1995 US 429083

(43) Date of publication of application:
20.11.1996 Bulletin 1996/47

- **PATENT ABSTRACTS OF JAPAN** vol. 014, no. 370 (C-0747), 10 August 1990 & JP 02 136146 A (**YOSHIDA DENTAL MFG CO LTD**), 24 May 1990,
- **PATENT ABSTRACTS OF JAPAN** vol. 002, no. 135 (M-039), 10 November 1978 & JP 53 106254 A (**MATSUSHITA ELECTRIC WORKS**), 16 September 1978,
- **J. PHOTOCHEM. PHOTOBIOOL. B: BIOL.**, vol. 21, 1993, ELSEVIER, pages 81-86, XP000579457
VALDUGA ET AL.: "Effect of extracellularly generated singlet oxygen on Gram-positive and Gram-negative bacteria"

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Description

[0001] The invention relates generally to a tooth and mouth cleaning or treatment instrument and to a dental liquid or paste used in conjunction with the tooth and mouth cleaning or treatment instrument.

[0002] Generally in the prior art mechanical cleaning of teeth with manual, electric and/or water jet devices is of a superficial nature only and does not penetrate into the skin-tissue or into pockets to remove or destroy bacteria and viral contamination. Additionally, toothpaste is of very limited effect in terms of bacterial and viral destruction. Low power laser biostimulation produces enzymes which can destroy viruses and bacteria present on teeth, in the mouth, on the gums and below the gum line. Consequential inflammation and pain is also eliminated. Radiation with pulsed diode laser at varying repetition rate frequencies is a selective trigger of the body's natural defense to infection within the mouth. Optimum effect can be achieved with GaAs (Gallium Arsenide) pulsed diode laser at a width of 200-300 nsec, $\lambda=904\text{ nm}$, power = 5-10 mW, application time 1-3 minutes. Three different repetition rate frequencies can be used to treat different dental conditions as follows:

F1 = 73 Hz for Parodontitis, dental pain

F2 = 292 Hz for Gingivitis, stomatitis

F3 = 584 Hz for Gingivitis, stomatitis, parodontopathies

[0003] It is known through research in the area of photodynamic therapy that certain substances are created as a byproduct of laser radiation. These substances contain atomic or singlet oxygen that is believed to destroy tumor cells. Similarly, atomic oxygen resulting from laser radiation can enhance destruction of oral bacteria and viruses. Research has been conducted and reported which teaches that gram-positive and gram-negative bacteria are sensitive to singlet oxygen generated by a physically separated photosensitizer. Thus, laser radiation will destroy oral bacteria. [See, e.g., Giuliana Valduga et al., "Effect of Extracellularly Generated Singlet Oxygen on Gram-positive and Gram-negative Bacteria," *J. Photochem. Photobiol. B. Biol.*, 21(1993) 81-86.]

[0004] The wavelength at which the diode laser of the device is operated is related to the specific photosensitizer used. A photosensitizer such as a Phthalocyanine can be activated by continuous wave diode laser as follows:

- (a) Zn(II) phthalocyanine is activated at $\lambda=670\text{ nm}$
- (b) Si(IV) naphthalocyanine is activated at $\lambda=780\text{ nm}$
- (c) Pd(OBu)₄ naphthalocyanine is activated at $\lambda=820\text{ nm}$

[0005] In EP-A-0593375, a dental appliance for brushing teeth is described. In it a laser beam is sent

down a central channel within the tooth brush until it hits one or more of semi-reflective elements and a final fully reflective element. The reflective elements are fixed within the head of the brush and use the principles of reflective optics to direct the laser beam parallel to the long axes of the bristles on the brush. The material of the head of the brush is a transparent plastic which allows the laser light to exit the head, after it is deflected, through spacing between bristles.

[0006] Once the laser is activated, its light is deflected by the reflective elements and exits the tooth brush. In some embodiments the laser beam travels through some plastic before striking the reflective elements and being deflected essentially perpendicular to its original traveling direction.

[0007] The present invention addresses the need for an oral cleaning or treatment device which will have a significant destructive effect on bacteria and viruses that will be reproducible over time, and which provides for safe, simple operation.

[0008] The objectives of the invention are as follows:

1. To provide a device to permit the delivery of low power radiation through a liquid jet or jets within the device.
2. To provide a device that permits the delivery of low power radiation directly from a low-power small radiator such as a diode-laser to areas of the oral areas to be treated or cleaned.
3. To provide a device that may be used separately from a cleaning device if desired, and that may provide variable treatment combinations by the selection of switches that control the radiation source, and that may provide sanitary, disposable treatment or cleaning portions of the device to allow multiple users to take advantage of the device.
4. To provide a cleaning material defined as a toothpaste or liquid to be used with the oral cleaning device which is radiation activated at certain wavelengths.
5. To respond to the need for an inexpensive, consumer-oriented hand-held tooth and mouth cleaning device which will emit low-power laser radiation for in-home treatment of oral infections, gingivitis and periodontal disease and for use by dentists and oral surgeons in preparation for surgery, in treatment of oral infection or during oral surgical procedures. Used in conjunction with the radiation activated toothpaste or liquid the effect on oral inflammation and infection is significant.

[0009] The present invention provides an oral cleaning device using low power radiation which enhances destruction of oral viruses and bacteria, increases blood circulation and thereby increases the body's immune system response to an oral infection. The present invention teaches a device which will have a significant effect on the treatment of all types of oral diseases, inflammation

tions, and infections.

[0010] As an alternative to a pulsed diode laser, a continuous wave diode laser can be used with or without a photosensitizer liquid for selective biostimulation.

[0011] Low power laser radiation also increases blood circulation to maintain dental and gum health. The invention addresses these needs by teaching a consumer oriented device combining the benefits of mechanical cleaning with tissue penetration and virus/bacterial elimination using low power radiation delivered with either a pulsed or continuous wave mode.

[0012] The invention also teaches a photosensitizer dental liquid or paste to be used with the dental laser brush device which is activated by a laser wavelength. The photosensitizer toothpastes or liquid supplements increases the effectiveness of the laser assisted cleaning instrument.

[0013] The above, and other objects, features and advantages of the present invention will become apparent from the following description read in conjunction with the accompanying drawings.

[0014] Figure 1 is a view of the end of the mechanical oral cleaning device showing a circular fixed tip, optical fiber and liquid jet within the brushhead for laser radiation delivery, where the fiber optic's end terminates in at a safety-designed angle.

[0015] Figure 2 is a view of the end of a mechanical oral cleaning device of Figure 1 having a circular rotating tip.

[0016] Figure 3 is a sectional view of the mechanical oral cleaning device showing a brushhead, diode laser, power supply, cooling means and driver.

[0017] Figure 4 shows a mechanical oral cleaning device placed within a console having a colored, replaceable brush tips, means for a dental liquid dispenser and electrical components.

[0018] Figure 1 shows a preferred embodiment of the invention in which plastic brush 50 can be manufactured in a multiplicity of colors and is removable from a handle. Plastic brush 50 contains brushhead 56, optical fiber 51 and water or liquid passage 52. Optical fiber 51 carries radiation from a radiation source to fiber end 53, which terminates at designated angle 54 relative to optical fiber 51's longitudinal axis. Water or liquid passage 52 carries water or liquid under pressure to fiber end 53. Water or liquid passes through passage 52, over surface of fiber end 53, and then through liquid and laser radiation delivery opening 55 in brushhead 56 to any proximal oral area to be cleaned or treated. Plastic brush 50 is designed to be safe for home use by the fact that laser radiation coming to fiber end 53 will be reflected harmlessly upward into plastic brush 50 if no liquid is being forced through liquid passage 52. This is due to angle 54 which creates a reflective surface because air and optical fiber 51 have substantially different n. When liquid is passing over the surface of fiber end 53 laser radiation will pass through substantially parallel to the longitudinal axis of optical fiber 51, thereby being delivered

to oral areas to be cleaned or treated via opening 55 with the liquid that came through passage 52. This occurs because the difference in n between optical fiber 51 and a liquid or water is low enough that fiber end 53 is now a refractive, rather than a reflective, surface.

[0019] Figure 2 shows another preferred embodiment of the invention in which plastic brush 20 can be manufactured in a multiplicity of colors, is removable from a handle, and has rotatable brushhead 28. Plastic brush 20 contains optical fiber 21 and water or liquid passage 22. Optical fiber 21 carries radiation from a radiation source to fiber end 23, which terminates at designated angle 24 relative to optical fiber 21's longitudinal axis. Water or liquid passage 22 carries water or liquid under pressure to fiber end 23 just before rotatable brushhead 28. As described with reference to Figure 1, water or liquid passes through passage 22, over surface of fiber end 23 and then through liquid and laser radiation delivery opening 25 to the oral areas being cleaned or treated. The rotating toothbrush bristles can facilitate cleaning or treatment in addition to the activity described earlier for the invention system.

[0020] Radiation is delivered by a pulsed diode laser or a continuous wave diode laser, to exactly where it is needed through plastic brush tips 50 or 20 in the normal course of tooth brushing. The present invention in these embodiments incorporates the properties of simple laser biostimulation which produces enzymes which remove and reduce the byproducts of tissue inflammation and thereby reduce swelling and assist to alleviate pain in the inflamed tissue.

[0021] Figure 3 shows handle means 31 containing diode laser 32 and electrical wiring 33, and cooling means 34 consisting of a Peltier cell. Radiation from diode laser 32 is delivered through replaceable brush 35. Handle means 31 may also contain battery cell or cells 36 which power diode laser 32.

[0022] Figure 4 shows the mechanical oral cleaning device placed within console 41 whereby the handle means 42 enclosing a diode laser is secured and replacement brushes 43 are easily accessible. Console 41 also contains container 44 for storage of the dental or photosensitizer liquid or paste. Console 41 contains within its structure a sufficient length of cable for use of the brushing device in dental surgery or for any other application. Console 41 also contains within its structure a micropump for any liquid under pressure that may be needed and all needed electrical circuits.

[0023] In the present invention, the dental laser brushing device can be used in combination with a photosensitizer toothpaste or liquid which is applied to the bristles of the device. The photosensitizer liquid or paste when activated by an appropriate laser wavelength produces hyperactive singlet oxygen that destroys bacteria. The method is similar to photodynamic therapy of tumors in which the photosensitizer releases singlet oxygen that destroys tumor cells. The present invention uses low power laser energy delivered by pulsed or by continuous

wave!action!and!a!low!concentration!of!photosensitizer for!consumer!use.!The!dental!laser!brushing!device!may be!used!in!connection!with!oral!surgery!at!a!medium!la-
ser!energy!delivery!and!using!a!specific!concentration of!photosensitizer!liquid.!The!present!invention!guaran-
tees!good!penetration!of!oral!tissues.

[0024] The!low!power!radiation!can!be!delivered!at three! (3)! different! frequencies! which! can! be! selected! by the! operator! based! upon! the! particular! treatment! to! be rendered! and! the! particular! photosensitizer! liquid! used. The! result! is! photodynamic! therapy! whereby! the! selec-
tion! of! diode! laser! wavelength! is! related! to! the! type! of treatment! to! be! conducted.

[0025] In! a! preferred! embodiment! of! the! invention! and as! shown! in! the! drawings,! the! diode! laser! can! be! incor-
porated! into! the! handle! of! the! device! together! with! its power! supply! and! if! necessary,! with! Peltier! cells! as! a cooling! system.! Radiation! from! a! diode! laser! source! is delivered! through! one! or! more! of! the! bristles! on! a! re-
placeable! brush! that! has! a! fixed! or! rotatable! brushhead, or! through! liquid! jets,! or! through! openings! in! the! brush-
head! corresponding! to! the! radiation! delivery! medium. The! diode! laser! will! run! on! the! battery! or! battery! cells inside! the! handle.! The! replaceable! brushes! have! one! of two! types! of! brushheads:

- (a) rotating! bristles! which! are! activated! by! applying the! bristles! to! the! oral! surface! or! by! the! pressure! of the! flow! of! liquid! through! the! jets;
- (b) fixed! bristles! which! are! activated! by! applying! the bristles! to! the! oral! surface! or! by! the! pressure! of! the flow! of! liquid! through! the! liquid! jets.

[0026] The! rotating! motion! of! the! bristles,! the! pulsing action! of! the! pulsed! delivery,! and/or! the! pressure! of! the liquid! jets! all! increase! the! effectiveness! of! the! device.

[0027] Also! in! a! preferred! embodiment! of! the! inven-
tion,! the! handle! containing! the! diode! laser! is! linked! to! a console! by! cable! where! there! are! electrical! wires! and small! tubing! for! delivery! of! the! dental! liquid.! The! console contains! all! the! necessary! electronic! components! for operation! of! the! dental! laser! brushing! device.! The! con-
sole! contains! a! container! to! hold! the! dental! liquid! or paste! and! its! micropump.! This! dental! liquid! can! be! a toothpaste,! a! pharmacological! substance! for! medical treatment! and/or! a! photosensitizer! liquid! for! photody-
namic-like! therapy.

[0028] Various! replacement! brushes! can! be! inserted into! the! handle! with! an! easy! snap! connection! that! guar-
antees! optical! connection! between! the! diode! laser! and the! optical! fiber! in! the! brush,! and! between! the! tubing that! delivers! the! dental! liquid! to! the! tubing! in! the! brush. The! brushes! may! be! different! colors! for! easy! individual identification! by! multiple! users! within! a! family.! The brushes! may! also! be! sterilized! for! professional! use! by dentists! and! oral! surgeons.

[0029] Having! described! the! preferred! embodiment! of the! invention! with! references! to! the! accompanying

drawings,! it! is! to! be! understood! that! beyond! the! precise description! above! the! invention! includes! changes! and modifications! effected! therein! by! one! skilled! in! the! art which! do! not! depart! from! the! invention! as! defined! in! the appended! claims.

Claims

1. A! dental! cleaning! or! treatment! device! having! a! han-
dle,! a! brushhead! (56)! comprising! a! backing! plate and! a! multiplicity! of! bristles,! a! radiation! source,! a power! source! for! the! radiation! source,! and,! a! means for! delivery! of! the! radiation! from! the! source! to! the free! end! of! the! bristles,! which! is **characterized! by:**
the! delivery! means! for! the! radiation! comprising an! optical! fiber! (51,!21)! optically! connected! to the! radiation! source;
the! optical! fiber! (51,!21)! terminating! such! that the! optical! fiber's! longitudinal! axis! is! substan-
tially! directed! at! an! opening! (55,!25)! in! the brushhead! (56);
the! opening! (55,!25)! allowing! passage! of! liquid and! radiation! to! oral! areas! to! be! cleaned;
a! tube! (52,!22)! providing! passage! for! liquid! under! pressure;
the! optical! fiber! (51,!21)! has! a! termination-tip (53,!23)! which! forms! a! substantially! flat! surface relative! to! the! optical! fiber's! longitudinal! axis;
the! tube! (52,!22)! has! an! open-end! substantially near! the! termination-tip! (53,!23);
a! liquid! coming! through! the! open-end! passes over! the! surface! of! the! termination-tip! (53,!23);
an! angle! formed! between! the! surface! of! the! ter-
mination! tip! (53,!23)! and! the! optical! fiber's! lon-
gitudinal! axis! forms! a! substantially! refractive surface! for! the! radiation! while! liquid! is! passing over! the! surface! and! then! to! the! opening! there-
by! passing! the! radiation! substantially! through the! opening! (55,!25);
the! angle! forming! a! substantially! reflective! sur-
face! for! the! radiation! when! the! liquid! is! not passing! over! the! surface,! thereby! passing! the radiation! substantially! to! the! brushhead! (56).
2. A! dental! device! of! claim! 1! further **characterized! by:**
the! radiation! source! being! a! diode-laser! either enclosed! in! the! handle! (31)! or! in! a! separate! en-
closure! and! connected! to! the! handle! (31)! by! an optically! conductive! means.
3. A! dental! device! of! claims! 1! or! 2! further **character-
ized! by!:**
the! device! having! at! least! a! brushhead! (56)
which! is! considered! disposable.

4. A dental device of claims 1, 2 or 3 further characterized by: the brushhead (56) and the handle being substantially rigidly connected by an attachment means such that the brushhead may be used to apply needed pressure to oral areas, and where the attachment means allows brushheads to be changed.

5. A dental device of claim 4 further characterized by:

the brushhead backing plate and the multiplicity of bristles being connected by a rotating means (28), allowing said bristles to move relative to said backing plate.

6. A dental device of claims 1, 2, 3, 4 or 5 further characterized by:

having means to deliver and select different radiation frequencies for treatment of a particular oral infection or condition.

7. A dental device of claims 1, 2, 3, 4, 5 or 6 further characterized by:

having a means to deliver and select laser radiation in a pulsed mode or in a continuous wave mode.

8. A method of using the dental cleaning or treatment device according to any of claims 1-7 wherein a dental liquid or paste containing photosensitizer substances is used with the dental device, which can activate the photosensitizer substance on an oral area covered with the liquid or paste.

9. A method according to claim 8 of using the dental cleaning or treatment device wherein either concurrently or after

application of the photosensitizer substance to oral areas the substance is activated by exposure to the radiation source of the device.

Patentansprüche

1. Eine zahnmedizinische Reinigungs- oder Behandlungsvorrichtung mit einem Griff, einem Burstenkopf (56) mit einer Grundplatte und einer Vielzahl von Borsten, einer Strahlungsquelle, einer Stromquelle für die Strahlungsquelle, und einem Mittel zur Zuführung der Strahlung von der Strahlungsquelle zum freien Ende der Borsten, **dadurch gekennzeichnet, dass:**

das Mittel zur Zuführung für die Strahlung eine optische Faser (51, 21) umfasst, die optisch mit

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der Strahlungsquelle verbunden ist; die optische Faser (51, 21) am Ende so abgeschlossen ist, dass die Langsachse der optischen Faser im wesentlichen auf eine Öffnung (55, 25) in dem Burstenkopf (56) gerichtet ist; die Öffnung (55, 25) den Durchtritt von Flüssigkeit und Strahlung in zu reinigende Mundbereiche erlaubt;

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ein Rohrchen (52, 22) den Durchfluss von unter Druck befindlicher Flüssigkeit ermöglicht; die optische Faser (51, 21) eine Abschluss-Spitze (53, 23) besitzt, die bezogen auf die Langsachse der optischen Faser, eine im wesentlichen flache Oberfläche bildet; das Rohrchen (52, 22) im wesentlichen im Bereich der Abschluss-Spitze (53, 23) ein offenes Ende aufweist;

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eine Flüssigkeit, die aus dem offenen Ende austritt, Ober die Oberfläche der Abschluss-Spitze (53, 23) fließt;

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ein Winkel zwischen der Oberfläche der Abschluss-Spitze (53, 23) und der Langsachse der optischen Faser im wesentlichen eine Brechungsfläche für die Strahlung bildet, während Flüssigkeit Ober die Oberfläche und dann zu der Öffnung fließt, wodurch die Strahlung im wesentlichen durch die Öffnung (55, 25) geführt wird;

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der Winkel im wesentlichen eine reflektierende Fläche für die Strahlung bildet, wenn die Flüssigkeit nicht Ober die Oberfläche läuft, wodurch die Strahlung im wesentlichen in den Burstenkopf (56) geführt wird.

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2. Eine zahnmedizinische Vorrichtung nach Anspruch 1, weiter **dadurch gekennzeichnet, dass:**

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die Strahlungsquelle ein Diodenlaser ist, der sich entweder in dem Griff (31) oder in einem getrennten Gehäuse befindet und mit dem Griff (31) Ober ein optisch leitendes Mittel verbunden ist.

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3. Eine zahnmedizinische Vorrichtung nach Anspruch 1 oder 2, weiter **dadurch gekennzeichnet, dass:**

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die Vorrichtung mindestens einen Burstenkopf (56) hat, der als Einwegartikel betrachtet wird.

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4. Eine zahnmedizinische Vorrichtung nach Anspruch 1, 2 oder 3, weiter **dadurch gekennzeichnet, dass:**

der Burstenkopf (56) und der Griff im wesentlichen starr Ober eine Halterung miteinander verbunden sind, so dass Ober den Burstenkopf der notwendige Druck auf die betreffenden Mundbereiche ausgeübt werden kann und wobei die

Halterung! ein! Auswechseln! des! BOrstenkopfes
erlaubt.

5. Eine! zahnmedizinische! Vorrichtung! nach! Anspruch
4,! weiter **dadurch! gekennzeichnet!, dass:**

die Grundplatte! des! Burstenkopfes! and! die
Vielzahl! der! Borsten! Ober! eine! drehbare! Vor-
richtung! (28)! miteinander! verbunden! sind!, die
eine! Bewegung! der! genannten! Borsten! in! Be-
zug! zu! der! genannten! Grundplatte! ermoglicht.

6. Eine! zahnmedizinische! Vorrichtung! nach! Anspruch
1,!2,!3,!4! oder! 5,! weiter **dadurch! gekennzeichnet!, dass:**

sie! Mittel! zur! Zufuhrung! and! Auswahl! ver-
schiedener! Strahlungsfrequenzen! zur! Behandlung
einer! bestimmten! Infektion! oder! eines! be-
stimmten! Zustandes! im! Mund! aufweist.

7. Eine! zahnmedizinische! Vorrichtung! nach! Anspruch
1,!2, **3,!4,!5** oder! 6,! weiter **gekennzeichnet! da-
durch!, dass:**

sie! ein! Mittel! zur! Zufuhrung! and! Auswahl! von
Laserstrahlung! im! Impuisbetrieb! (pulsed! mo-
de)! oder! im! Dauerbetrieb! (continuous! wave
mode)! aufweist.

8. Eine! Methode! zur! Verwendung! der! zahnmedizini-
schen! Reinigungs-! oder! Behandlungsvorrichtung
nach! einem! der! Ansprache! 1! bis! 7,! bei! der! eine
zahnmedizinische! FIosigkeit! oder! Paste,! die! Pho-
tosensibilisatorsubstanzen! enthalt!, in! Verbindung
mit! der! zahnmedizinischen! Vorrichtung! verwendet
wird, welche! die! Photosensibilisatorsubstanz! auf
einem! Mundbereich,! der! mit! der! FIosigkeit! oder
Paste! bedeckt! ist,! aktivieren! kann.

9. Eine! Methode! nach! Anspruch! 8! zur! Verwendung
der! zahnmedizinischen! Reinigungs-! oder! Behand-
lungsvorrichtung,! bei! der! entweder! gleichzeitig
oder! nach! Aufbringung! der! Photosensibilisatorsub-
stanz! auf! die! Mundbereiche! die! Substanz! aktivierte
wird,! indem! man! sie! der! Strahlungsquelle! der! Vor-
richtung! aussetzt.

Revendications

1. Un! dispositif! de! nettoyage! ou! de! traitement! dentaire
doté! d'une! poignée,! d'une! tête! de! brosse! (56)! com-
prenant! une! plaque! de! support! et! une! variété! de
brosses,! d'une! source! de! rayonnement,! d'une! sour-
ce! de! courant! pour! la! source! de! rayonnement! et
d'un! moyen! pour! le! transport! du! rayonnement! de! la
source! à! l'extremité! libre! des! brosses,! qui! est! ca-

caracterise! par! :

le moyen! de! transport! du! rayonnement! qui
comprend! une! fibre! optique! (51,!21)! dotee
d'une! connexion! optique! avec! la! source! de
rayonnement!;

la! fibre! optique! (51,!21)! qui! se! termine! de! telle
maniere! que! ('axe! longitudinal! de! la! fibre! opti-
que! est! substantiellement! dirige! vers! une
ouverture! (55,!25)! dans! la! tête! de! brosse! (56)! ;
('ouverture! (55,!25)! qui! permet! le! passage! du
liquide! et! du! rayonnement! vers! les! zones! bucc-
cales a nettoyer!;

un! tube! (52,!22)! permettant! le! passage! de! liqui-
de! sous! pression!;

la! fibre! optique! (51,!21)! a! une! extremite! (53,!23)
qui! forme! une! surface! substantiellement! plate
par! rapport! à! ('axe! longitudinal! de! la! fibre
optique!;

le! tube! (52,!22)! a! une! extremite! ouverte! sub-
stantiellement! proche! de! l'extremite! (53,!23);
un! liquide! qui! traverse! l'extremite! ouverte! pas-
se! sur! la! surface! de! l'extremite! distale! (53,!23);
un! angle! forme! entre! la! surface! de! l'extremite
(53,!23)! et! ('axe! longitudinal! de! la! fibre! optique
forme! une! surface! de! refraction! substantielle
pour! le! rayonnement! alors! que! le! liquide! passe
sur! la! surface! puis! vers! ('ouverture,! faisant! alors
passer! substantiellement! le! rayonnement! à! tra-
vers! ('ouverture! (55,!25);

('angle! qui! forme! une! surface! de! reflexion! sub-
stantielle! pour! la! radiation! quand! le! liquide! ne
passe! pas! sur! la! surface,! et! qui! fait! alors! passer
le! rayonnement! vers! la! tête! de! brosse! de! ma-
niere! substantielle! (56).

2. Un! dispositif! dentaire! conforme! à! la! revendication
1 en! outre **caracterise! par!**:

la! source! de! rayonnement,! qui! est! un! laser! a
diode! logé! soit! dans! la! poignée! (31),! soit! dans
un! logement! sépare! et! relié! à! la! poignée! (31)
par! un! moyen! de! conduction! optique.

45 3. Un! dispositif! dentaire! conforme! aux! revendications
1 ou! 2! en! outre **caracterise! par**

le! dispositif! qui! a! au! moins! une! tête! de! brosse
(56)! considéré! comme! jetable.

4. Un! dispositif! dentaire! conforme! aux! revendications
1,!2! ou! 3! en! outre **caracterise! par!**

la! tête! de! brosse! (56)! et! la! poignée,! qui! sont
substantiellement! connectées! de! maniere! rigi-
de! par! un! moyen! de! fixation! qui! permet! d'utiliser
la! tête! de! brosse! pour! appliquer! la! pression! ne-
cessaire! aux! zones! buccales,! le! moyen! de! fixa-

tion! permettant! de! changer! la! taste! de! brosse.

5. Un! dispositif! dentaire! conforme a la! revendication
4! en! autre **caracterise! par!:**

la! plaque! de! support! de! la! taste! de! brosse! et! la
variete! de! brosses! connectees! par! un! moyen
rotatif! (28),! qui! permettent! aux! dites! brosses! de
bouger! par! rapport a la! dite! plaque! de! support.

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6. Un! dispositif! dentaire! conforme! aux! revendications
1,!2,!3,!4! ou! 5! en! autre **caracterise! par!:**

la! presence! de! moyens! de! transport! et! de! se-
lection! de! differentes! frequences! de! rayonne-
ment! pour! le! traitement! d'une! infection! ou! d'un
&tat! buccal! particuliers.

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7. Un! dispositif! dentaire! conforme! aux! revendications
1,!2,!3,!4,!5! ou! 6! en! autre **caracterise! par!:**

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la! presence! d'un! moyen! de! transport! et! de! se-
lection! de! rayonnement! laser! en! mode! pulse! ou
en! mode! de! guide! d'ondes! continu.

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8. Une! methode! qui! utilise! le! dispositif! de! nettoyage
ou! de! traitement! dentaire! conformement a chacune
des! revendications! 1 a 7,! dans! laquelle! un! liquide
ou! une! pate! dentaire! contenant! des! substances
photosensibles! sont! utilises! avec! le! dispositif! den-
taire!,! qui! peut! activer! la! substance! photosensible
sur! une! zone! buccale! couverte! du! liquide! ou! de! la
pate.

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9. Une! methode! conforme a la! revendication! 8! d'utili-
sation! du! dispositif! de! nettoyage! ou! de! traitement
dentaire!,! dans! laquelle! la! substance! photosensible
est! activee! par! exposition a la! source! de! rayonne-
ment! du! dispositif! pendant! ou! apres! l'application! de
cette! derniere! sur! les! zones! buccales.

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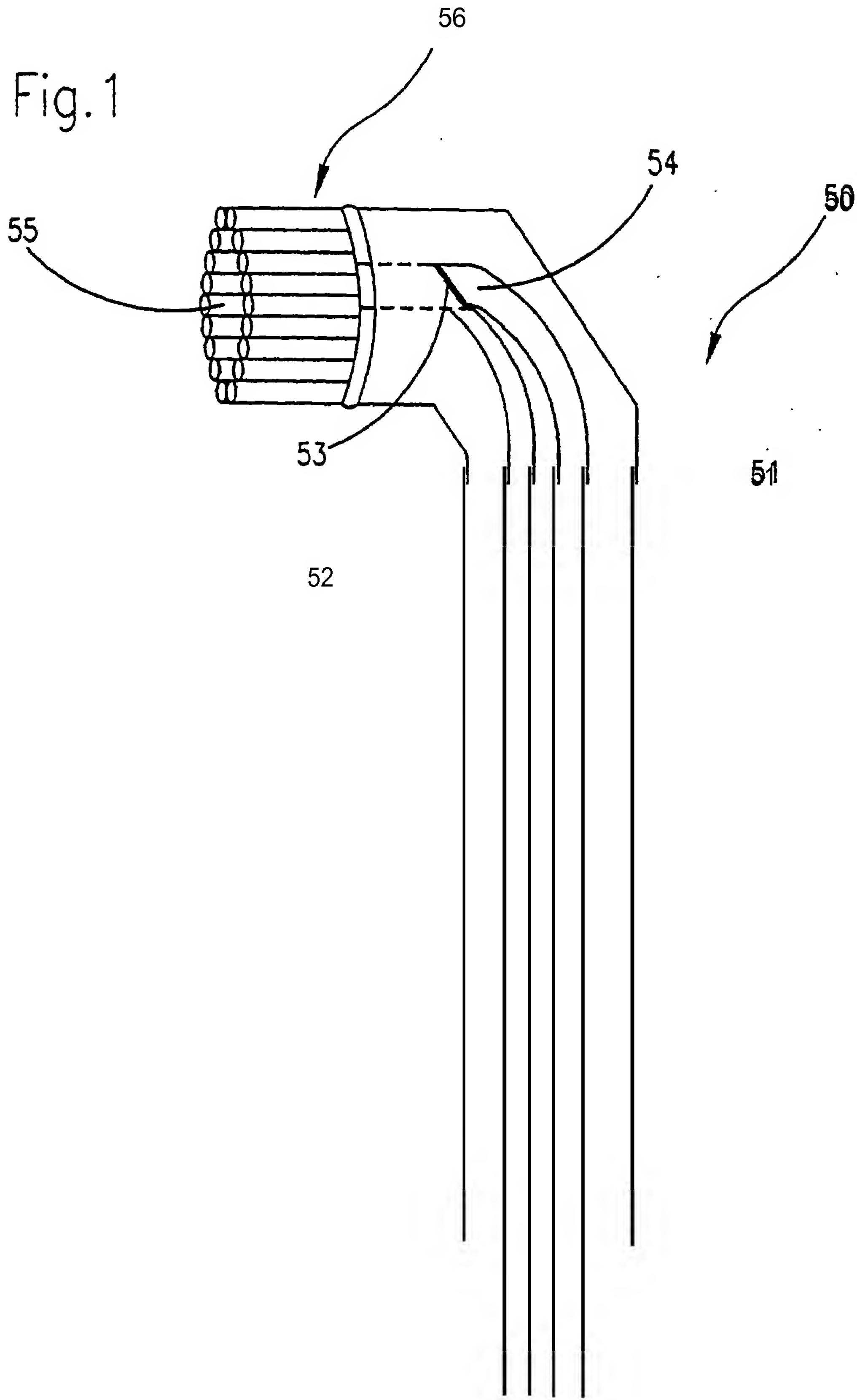


Fig.2

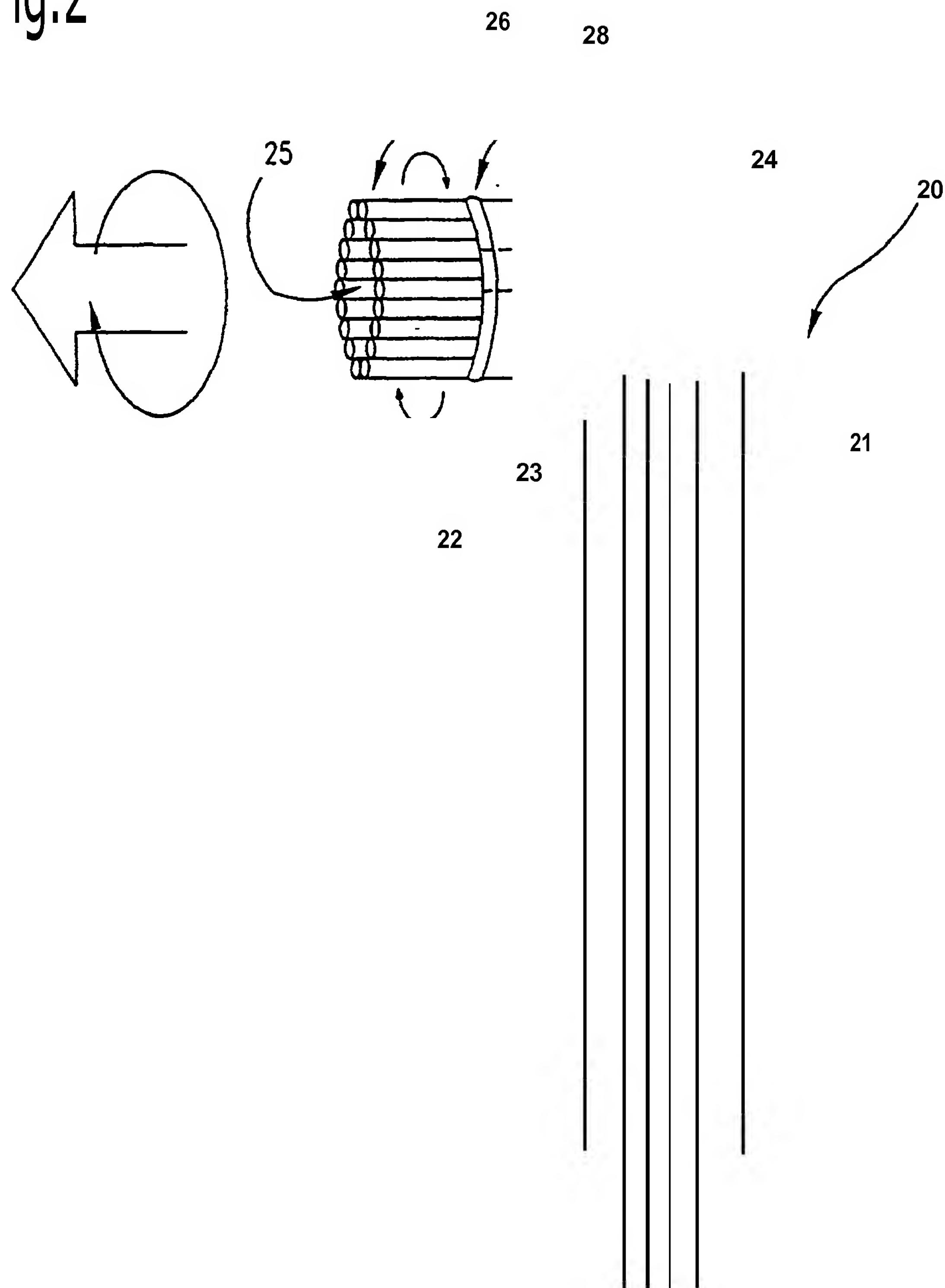
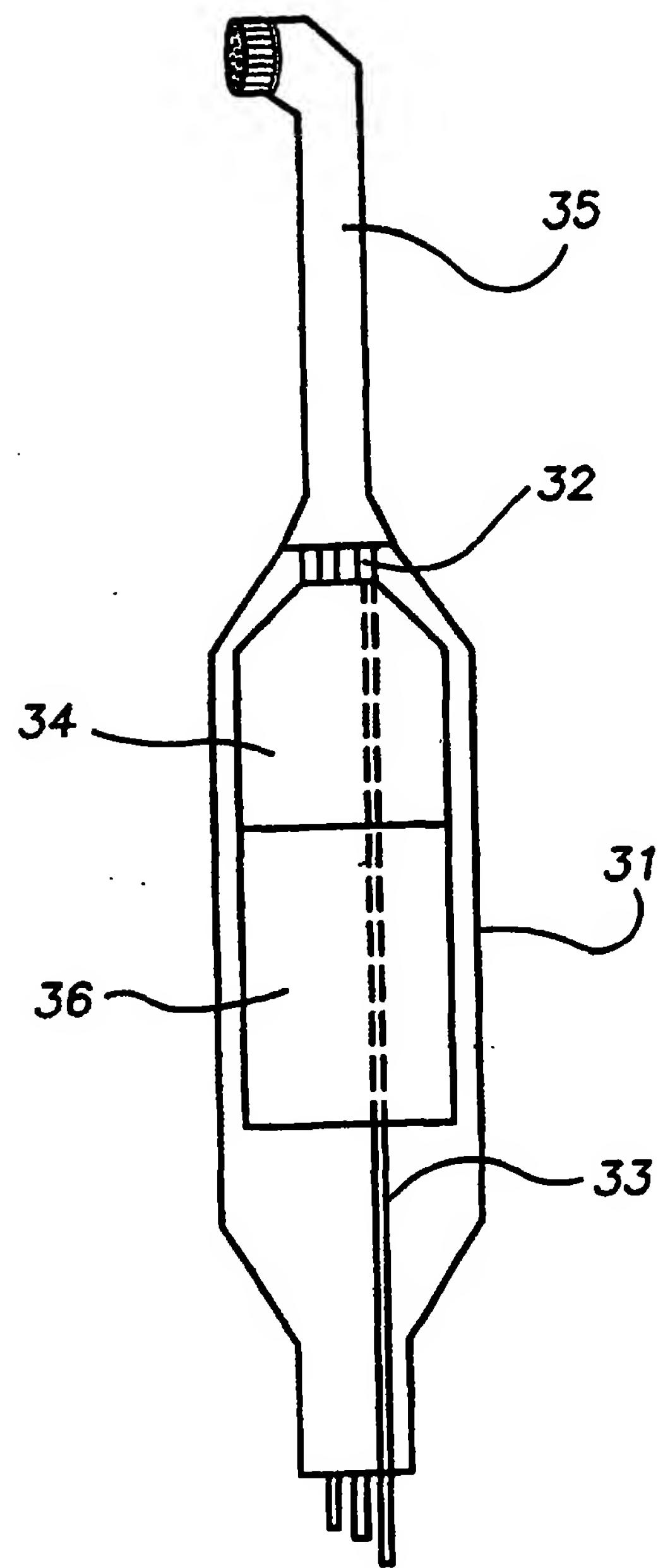
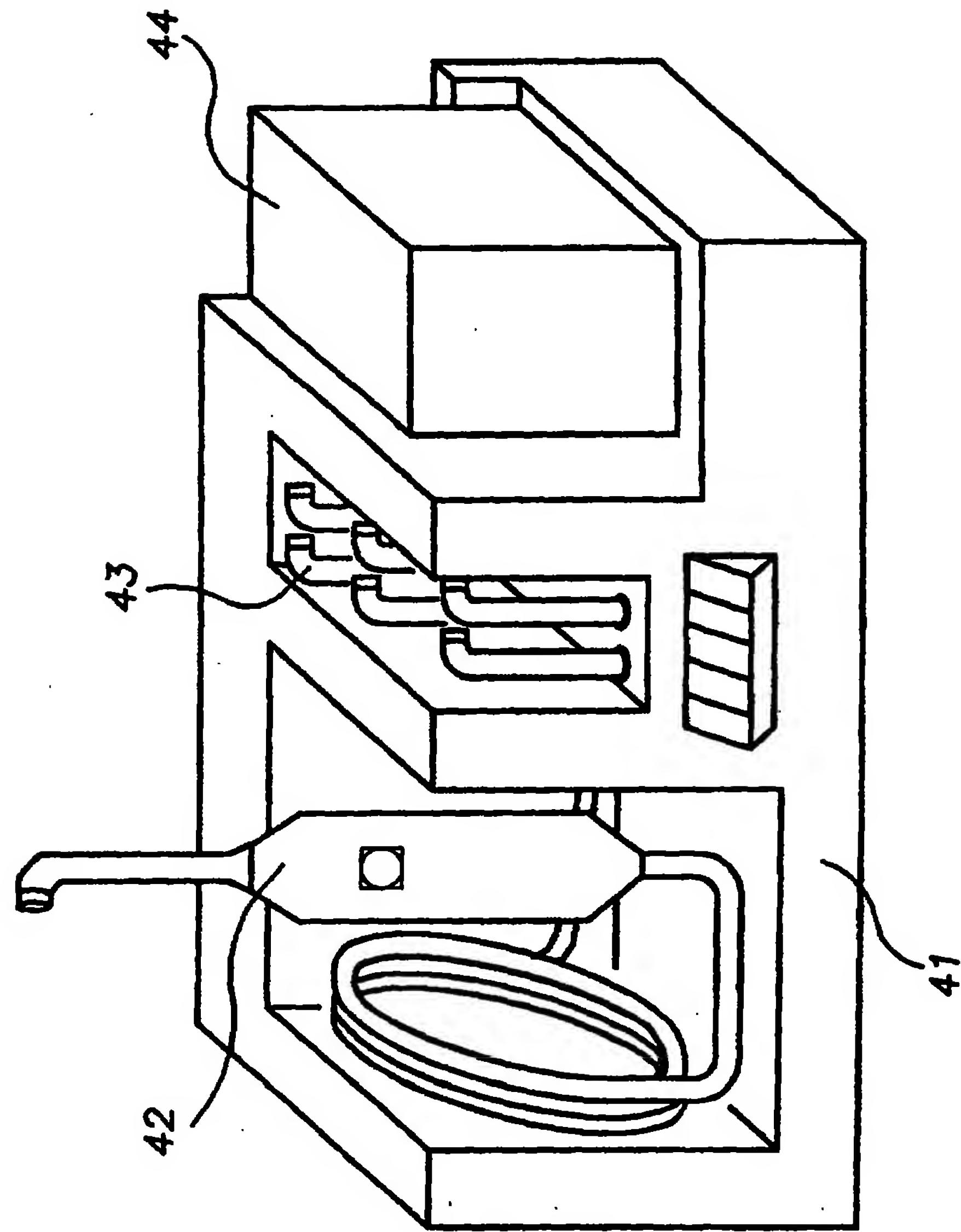


FIG.3



EP!0!743!029!B1



FIG